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ABSTRACT

This paper lies at the interpretive intersection of several lines of research, some of them quite familiar to mathematics educators, and some of them probably less so. Among familiar discourses are cognitive constructivism, social construction, situated learning, and the psychological study of differences between groups defined by gender, race, ethnicity, and other variables used to categorize persons. Less familiar literatures and discourses include cultural studies, feminist research and theorizing, and postmodern social sciences, among others. Within the space inscribed by these theories, discourses, and research traditions and findings, this paper excavates issues surrounding the basic questions of what knowledge and approaches can be applied in order to increase the "fairness in dealing" with all students in and through mathematics curriculum, instruction, assessment, and related activities. And what are the implications for research in mathematics education, particularly research that invokes and pursues knowledge categorized as psychological? Contains 112 references. (Author/MKR)

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Fairness in Dealing: Diversity, Psychology, and Mathematics Education

Suzanne K. Damarin

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FAIRNESS IN DEALING: DIVERSITY, PSYCHOLOGY, AND MATHEMATICS EDUCATION

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> But constructivism as a pedagogical orientation has to be embedded in an ethical or political framework.
>
> *Nel Noddings, 1993, p. 159*

This paper lies at the interpretive intersection of several lines of research, some of them quite familiar to mathematics educators, and some of them probably less so, or at least familiar only to some. Among the familiar discourses are cognitive constructivism, social construction, situated learning, and the psychological study of differences between groups defined by gender, race, ethnicity, and other variables used to categorize persons. The less familiar literatures and discourses include cultural studies, feminist research and theorizing, and postmodern social sciences, among others. Within the space inscribed by these theories, discourses, and research traditions and findings, I excavate issues surrounding the basic questions of what knowledge and approaches can be applied in order to increase the "fairness in dealing" with all students in and through mathematics curriculum, instruction, assessment, and related activities. And, what are the implications for research in mathematics education, particularly research which invokes and pursues knowledge categorized as psychological?

I choose to use the term "fairness in dealing" specifically to displace the more traditional ideas of equity. Educational equity (if it is achieved) connotes various forms of measured equality in the selection, preparation, treatment, achievement, and/or career tracks of groups of students categorized by sex, race, ethnicity, or class (Fennema, 1990). The equity concept is limited in several regards. First, it is measure dependent, and different measures often yield different assessments of the extent to which equity is achieved; thus, while the quantitative nature of equity reports lend them the aura of scientific truth, the construct validity is questionable. Secondly, equity and its measures cannot take into account phenomena such as the accumulating evidence that even many girls and women who have achieved excellence in mathematics often feel that some unfairness was involved. Third, measured equity is a post hoc concept, measured after the fact of preparation, achievement, et cetera, and offers mathematics educators no guidance as to how to work towards its achievement. A review of the literature reveals a fourth concern: "equity" and "excellence" are often regarded as pitted against each other by educational policy makers and philosophers, with the implication that one must be sacrificed for the other. As others have observed, if equity and excellence were consistent in practice, we would see at least a few examples of "excellence" in urban schools. The idea that in a democratic society excellence *must entail* equity is lost in the operational uses of the terms "equity" and "excellence".

Periodically throughout American educational history, arguments for equity in mathematics and/or science education have been confounded with arguments concerning the need of capitalists to increase labor pools (see Cohen, 1982; Damarin,

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1993a); thus, the idea of equity in children's access to education is confused with the idea of giving employers access to trained workers. While there are clear relationships between education and employment, this conceptual confusion deflects focus from the current educational needs of learners to future needs of employers. Current reform efforts in education and schooling in general, and in mathematics education as guided by the *Standards* (NCTM, 1989) in particular, focus on the construction of knowledge by the individual student. But, the measures used in gathering data for equity reports usually lead in directions opposite to the "authentic assessment" of the *Standards*. Finally, (and perhaps consequent upon the issues outlined above) educational activities directed toward (and by) the current equity construct have not led to the kinds or magnitude of change intended with the inception of systematic equity work in the 1970s. In a multicultural democratic society such as ours, the goal of universal education requires a rethinking and recommitment to the education, in particular the mathematical education, of all students. Toward this end, and in recognition of the power of language to inhibit or promote change, consider the idea of "fairness in dealing."

Fairness in Dealing

The term "fairness in dealing" is one of the definitions for equity supplied by *Webster's Ninth Collegiate Dictionary*. Although "dealing" and "fairness" are difficult words to define operationally, "dealing" conveys ideas of continuity in action, reciprocity (dealing cannot be accomplished by a single actor), and negotiation to resolution; "fairness" entails openness, honesty, full disclosure, and often the setting aside of knowledge or information that might bias one. When Myra and David Sadker (Sadker and Sadker, 1994) titled their recent book *Failing at Fairness: How Our Schools Cheat Girls*, they used "fairness" in this sense. Theirs is not an equity report *per se*, but a summing up of more than two decades of observational research focused on the schooling of girls; the book documents "a curriculum of sexist school lessons becoming secret mind games played against female children, our daughters, tomorrow's women" (p.1). Since 1973 when Myra Sadker published her first book, *Sexism in School and Society*, (Frazier and Sadker, 1973) and launched the contemporary study of gender in education, a growing cohort of educational and psychological researchers has conducted a great deal of research on gender in general and on mathematics and gender, in particular (see Fennema, 1993; Fennema and Hart, 1994). Despite the accumulated findings of the latter research, and despite earnest efforts by many mathematics teachers, curriculum designers, policy makers, and teacher educators to articulate research findings into classrooms, the recent findings of the Sadkers, the AAUW study of schooling and girls (Wellesley Center, 1992; also, Orenstein, 1994), and other comprehensive studies indicate that little has changed for girls or women in mathematics classes. But, the absence of some changes can motivate others, and in the area of gender and mathematics there is apparent today a worldwide movement (Kaiser and Rogers, 1995) to change the conceptual bases and paradigms of research on gender and mathematics, incorporating feminist philosophy and theories, feminist

studies in psychology, and ideas of fairness. This paper reflects, and perhaps contributes to, that change.

Considering Race and Ethnicity I

Although my assignment in this paper is to address diversity in general, the primary discussions and arguments are based in sex/gender/feminism for several reasons. First, much of my own work and, therefore, my greatest knowledge and my habitual focus are on gender. Secondly, the body of research and theory directed specifically toward mathematics and gender is larger, and perhaps more varied in its theoretical bases, than work on mathematics and race[1] (or mathematics and class[2]). Third, I argue below that the sex/gender/ feminisms based discussions presented here have clear analogues in the area of mathematics and race, as well as mathematics and ethnicity.

Before making that argument, it is important to note that white feminists have been rightly criticized for ignoring and/or denying racial differences between and among women in much of their work I do not deny the validity of this claim, nor its importance; I regret any and all participation on my part in this silencing. Certainly sex/gender and race operate both differently and interactively in the larger society. Just as research and writing on women have often focused on white women, research and writings on race and ethnicity have often ignored the multiplicity of races and ethnicities. In this paper, my race-based examples focus on African Americans. This choice reflects my desire to display the depth and richness of findings concerning a particular marginalized group. I have no doubt that a comparable set of examples and arguments could be given with respect to a different group, nor that in its details the discussion would vary with culture.

For both race and sex/gender, however, the domains of "mathematical ability" and "mathematics performance" have functioned as areas in which "demonstration of difference" has been used both as a rationalization for, and a tool in, the continuing suppression/ oppression of individuals based solely upon their race and/or sex. This structural and operational sameness is at the crux of the analogical moves in this paper. Moreover, the "red thread" that runs through the feminist analysis discussed below is the importance of recognizing and valuing lived experiences and epistemological standpoints in the psychological and educational study of cognition and in the teaching of mathematics. That these experiences and standpoints vary with both sex and race in relevant ways is a major point, and the basis of the analogies and comparisons between gender and race.

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[1] In a recent paper, Ladson-Billings and Tate (in press) argue that, in contrast with gender and class for which there is extensive theoretical work, race has not been adequately theorized. These authors propose and argue for a critical race theory grounded in the ownership of property.

[2] This paper will not address issues of mathematics and class in any depth. The interested reader is referred to Mellin-Olsen (1987), and Frankenstein (1987, 1995) for insightful discussions. Elsewhere, (Damarin 1993b, 1994a), I discuss some issues of class in relation to situated cognition; the arguments there are related to those of this paper.

Feminisms, Psychology, Gender, and Mathematics: A (very) Brief History

Although all feminist research and theorizing begins with the goal of improving the lot of women in the world, beyond this common aim feminism is not singular in its underlying assumptions, beliefs, methods, and goals. Instead, diverse feminists work within a range of perspectives and frameworks — liberal feminism, socialist feminisms of several sorts, radical feminisms, black womanist theories, and postmodern feminism among them.[3] Until recently, most research in gender and mathematics was carried out under the assumptions and using the methods associated with liberal feminism which assumes (basically) that the larger structures (e.g., capitalism, the scientific establishment, educational systems) and concepts (e.g., mathematics, science, research, evidence) of current society are stable, essential, and appropriate. Liberal feminists "work within the system", attempting to improve the lot of women within conceptual, experiential, and political systems which are otherwise left unchanged.

For research on gender and mathematics, liberal feminist researchers using current concepts and methods of psychology and education have conducted experimental studies, factorial studies, and the building of models in efforts to understand observed differences in the mathematics performance of females and males, to identify psychological variables which moderate effects, suppressing or multiplying the effects of gender, and to prescribe, both within and outside schools, changes in the treatment of girls which might increase mathematics performance. Beginning with the Fennema-Sherman studies of the early 1970s (Fennema and Sherman, 1977), and continuing into the present (e.g., Friedman, 1995) these studies have accumulated into a substantial comprehensive literature (see Fennema and Hart, 1994). Psychological constructs such as state and trait anxiety, internality/ externality, field dependence/ independence, aggression, fear of success, and achievement motivation, among others, contribute to the understanding of relations among the variables studied. At the same time, new constructs such as "math as a male domain" (Fennema and Sherman, 1977) and "autonomous learning behaviors" (Fennema and Peterson, 1985) were identified by these researchers and studied to clarify anomalous findings.

Despite the increasing refinement of studies and findings, however, dissatisfaction if not disillusionment with this line of research has grown among those concerned with gender and math for several reasons. After an initial flurry of concrete findings which suggested concrete actions, the results of this research seem to many to have neither explanatory power comparable to the perceived

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[3] For a discussion of various strands of feminism, see Jaggar (1983), Donovan (1986), or any introductory text on feminist theory. Black feminist (or womanist) theory has often been ignored in these texts, especially the earlier ones; for a discussion of these theories see Collins (1990) on black feminist theory and Walker (1983) on black womanism. The interested reader may also wish to consult Kramarae and Spender's (1992) anthology of writings on feminist theory and practice in fields ranging from Architecture to Zoology, or Stone's (1994) anthology on feminism and education.

magnitude of the problem nor prescriptive power sufficient to create fundamental change. Feelings that this line of research might have passed its usefulness were exacerbated by announcements of the welcome findings that the sexes "no longer differ" in mathematical ability or aptitude (Linn and Hyde, 1989) and by accumulating evidence (Linn and Hyde, 1989; Tartre, 1990) that spatial abilities are *not* related to sex differences in mathematical performance. The emergence of these findings both validated the "gut level" beliefs of many gender researchers and served to catalyze a change in direction. In the hotel lobbies at AERA meetings, at WME meetings, and in other places where gender and mathematics researchers come together, a tentative, forbidden thought began to take on the dimensions of a rallying cry: "There's nothing wrong with the women; let's stop trying to fix the women and start to work on fixing the mathematics." One way of interpreting the current agenda for research in mathematics and gender is that the problem under study is to determine exactly what those three words, "fix the mathematics" could possibly mean. Meanwhile, in many other areas of study, including psychology, feminist researchers using different approaches were uncovering interesting findings and propounding interesting theories.

Feminist Psychology

From its earliest development, psychology has been criticized by women within the field (e.g., Woolley, 1903, 1910) who found both the psychological conceptualization and empirical investigation of the "feminine" and its correlates to be without validity in that they were dissonant with the realities of women's lived experience. With the rise of the current wave of feminism, these criticisms were revived and expanded (Weisstein, 1971; Sherif, 1979). Researchers in psychology and education (e.g., Eichler, 1987; Squire, 1989) examined the conduct of experimental research, uncovering evidence of prevalent biases at the levels of problem statement, sampling, instrumentation, treatment, data analysis, and interpretation and reporting of results. A cataloging of these findings is well beyond the scope of this paper, but a few examples are instructive. In a sampling of studies of interactions between parents and their young children, most were conducted using observations of mothers; findings of good interactions were typically reported in the gender-neutral language of parenting while findings of deficient behaviors were uniformly discussed in the female-specific language of mothering and maternal activity. While this failing might be corrected by re-analysis and interpretation of existing data or by new experimentation, there are more fundamental gender-based critiques. Psychological constructs which have prior associations with the masculine (e.g., aggression) tend to be studied using high-status experimental techniques, while those associated with the feminine (e.g., anxiety) are studied using low status Likert-type instruments. As a result, knowledge of "masculine" traits is reported with the certainty of cause and effect, while "feminine" traits emerge as correlational, marginally significant predictors lacking in strength. Thus, by their design, the research tools participate in the very phenomenon and problem that gender researchers have sought (and are seeking) to address

and redress. In this context, the wisdom of black feminist Audre Lorde (1984, p. 110) is evident: "the master's tools will never dismantle the master's house."

From the perspective of women, another major failing in psychological research was (and is) the development, refinement and application of comprehensive theories of "human" development based entirely on male data. Kohlberg's theory of moral development has been particularly troublesome because when this four stage theory is applied to both sexes women are most frequently found to be in a state of arrested development (stage 3) while men proceed to the higher (fourth) stage. In a series of studies of women's moral development, Carol Gilligan (1979, 1982) developed an alternate theory around ideas of care and responsibility. Briefly, in her research and theories, a conception of the self as connected and in relation to others, together with a theory of knowledge as connected,[4] supports an ethic based on responsibility and care, while a view of the self as autonomous and in separation from others leads to an ethic of rights and justice. While women's beliefs and actions were in the spirit of the former, men believed and acted in relation to the latter. Rather than a stage theory, Gilligan's is a theory of socialized differentiation highly related to gender socialization.[5, 6]

Gilligan's work has had profound influence on feminist research and theory, and on applications of feminist theory to the (female dominated) "helping professions". Of particular interest here, this work influenced feminist psychological study in relation to another developmental stage theory which was based entirely on data gathered from males:[7] William Perry's (1970) *Forms of Intellectual and Ethical Development.* Basing their queries on Perry's stages, Mary Belenkey, Blythe Clinchy, Nancy Goldberger and Jill Tarule studied 135 women in various sites of post-secondary education. The resulting book, *Women's Ways of Knowing*, (Belenkey, et al., 1986, henceforth referred to as WWK) outlines six phases (not stages in the usual sense) in women's acquisition and organization of knowledge, and examines implications for the transformation of teaching. Since it's publication, *Women's Ways of Knowing* has been very influential on the study of gender and mathematics, as will be discussed below.

Before turning to that discussion, the recent work of two other psychologists merits attention; Sandra Bem (1993) and Meredith Kimball (in press) have both made extensive study of the massive volume of scholarly literature produced by

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[4] Connected knowing is described briefly below; a more extended but still brief discussion can be found in Becker (1995).

[5] The work of Nel Noddings (1984, 1992) on a caring ethic and care in schools is rooted in philosophy, not psychology, but is important to any discussion of care in schooling. The ethic of care has been adopted or adapted by many feminist ethicists, and seriously criticized by others; a brief synopsis of the critiques can be found in Damarin (1994c).

[6] The distinction between ethics of care and ethics of justice is related to the distinctions between an approach to education of diverse students based on fairness in dealing and an approach based on equity. Thus, this paper is within the tradition of educational thought inspired by Gilligan's work.

[7] Perry's subjects were Harvard students of the 1960s, that is, young (17-22), white, upper middle class and upper class males.

feminist scholars and theorists (in philosophy of science, epistemology, sociology, history, cultural studies, literary criticism, media criticism, law, and other areas) since the early 1980s, and have incorporated major ideas from these literatures into their work. Sandra Bem has been engaged in gender research since the 1960's, and is perhaps best known as co-developer (with Daryl Bem, her husband) of the Bem Sex Role Inventory. Her current work might be called a kind of (qualitative) meta-analysis of earlier work by herself and others in her generation of psychological researchers. Here, she argues that throughout this research sex/gender has functioned as a series of transparent, but distorting, lenses through which science looks at women and men, notably lenses of androcentrism, gender polarization, and biological essentialism. Examining the lenses in detail, she uses feminist epistemology and related literatures to expose the distortion, and argues that, especially if gender is to be depolarized, a revolution in psychology is needed.[8] Meredith Kimball may be a harbinger of that revolution; the importance of her work lies in her deconstruction of binary pairs which are basic to current psychological study: male/female, ethic of care/ethic of justice, connected/separate, gender similarity/gender difference, among others.[9]

Considering Race and Ethnicity II

Because contemporary science in general, and psychology in particular, have developed in a Euro-American tradition, and because feminist critiques are based in the effects of absences and biases at every level, these critiques invite analogues with respect to persons of non-white races and non-European cultures. Moreover, the constructions, within the dominant Euro-American discourses, of blacks (and all people of color) throughout the history of the human sciences since the time of Darwin is a history of the "mis-measure of man" (Gould, 1981) in the service of social agendas of white progress and supremacy (see Gould, 1981; Harding, 1991; Lewontin, 1992; and many studies cited therein). The contributions of Africans and African-Americans in particular, and of all people of color, to the development of science and technology have been denied, ignored and erased from the public record. The fields of Black Studies, Native American Studies, Latino Studies, and other fields of cultural study, including ethnomathematics, have emerged in recent decades in an effort by scholars from those cultures (primarily) to reclaim and correct some of this history and to reclaim for people of color not only the traditions of scholarship and science consistent with their life experiences but also recognition of their accomplishments throughout history.

The importance of recognizing and meeting through instruction the culturally specific ways in which students understand the world and their relation to it is central to much discussion of multicultural education (Sleeter and Grant, 1991; Banks, 1993; Secada, 1990; Delpit, 1988, and numerous others). Like other lenses

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[8] Bem's work provides for psychology findings comparable to those of work in biology (e.g., Fausto-Sterling, 1985) and primatology (Haraway, 1991).

[9] Within her work, Kimball pays particular attention to mathematics. Also, see Kimball (1989).

through which white educators peer, psychological theories reflect the world views and epistemologies of their developers. A part of the substantial literature of black psychology, Afrocentric psychology is one alternative to Eurocentric theories.

Afrocentric psychology, like other articulations of Afrocentric theory, is based in the study of the lives and history of Africans and African Americans. The centrality of faith, belief, and ethics to Afrocentric "Optimal Psychology" reflects the importance of these to the African experience and describes conceptual systems grounded in the spiritual as opposed to the material grounding of Euro-American psychological traditions. Importantly to mathematics education, this leads to an epistemology based in self-knowledge through symbolic imagery and rhythm in contrast to knowledge of the external world gained through scientific observation, measurement, and counting. In this approach, all things are seen as interrelated and knowledge is connected, not compartmentalized (Asante, 1987; Myers, 1988).

Study of optimal psychology can help white mathematics educators become open to the construction of new ideas about how black (and perhaps other students) organize and use knowledge. Building on the relations between optimal and Euro-American psychological theories (discussed in Myers, 1988), we can all gain different and fuller understandings of findings such as those of Stiff and Harvey (1988) that black students benefit from mathematics instruction based on field dependence. Optimal psychology invites us to view the "field" in more complex ways and to reach a different understanding of figure/ground interrelations and field dependence. With this new understanding, any biases which portray field dependent thinkers as mathematically dull should disappear, and we should be able to design more interesting and effective learning activities for field dependent thinkers.

Gender and Math Informed by Feminist Psychology

The epistemological model explicated in *Women's Ways of Knowing* describes six ways of knowing exhibited by the women studied; although they are listed and analyzed in WWK in an order that reflects growth from total reliance on others to self-reliance and autonomous knowing, the authors emphasize that these are not stages in the usual sense. Women may know differently dependent upon the knowledge domain, for example, and some women may be "boundary riders", mixing elements from two phases for long periods of time. Overall, women grow intellectually from one way of knowing to the next; the authors do not address knowing prior to adulthood, and therefore questions such as whether all female knowing begins with silence are not addressed. Briefly described, the ways of knowing are:

(1) *Silence*, characterized by belief that authorities are all-powerful, inability to form mental representations, absence of expectations of understanding

(2) *Received Knowing*, learning by listening, accepts authority in a rote manner ("whatever you say, doc")

(3) *Subjective Knowing*, knowing "in my gut"; "it's only my opinion, but my gut tells me ..."; assumes there are right answers

Procedural Knowing in two forms

(4) *Separate Knowing*, impersonal, propositional reasoning

(5) *Connected Knowing*, seeking explanations for perceptions, interested in the thoughts of others

(6) *Constructed Knowing*, effort to integrate knowledge, appreciates complexity

This model describes women's lives, in particular and as gleaned from the WWK data, in several ways. Silence is seen as an effect of generations of women's socialization to acquiesce to male authority. Subjective knowing identifies and valorizes what has traditionally been denigrated as "women's intuition." And, connected knowing identifies a kind of procedural knowing which is different from "masculine rationality," but qualifies as reasoning. Connected knowing is described (Gilligan 1982) as involving intuition, creativity, hypothesizing, relativism, induction, incompleteness; based on experience, it is contextual.

Researchers on gender and mathematics have used WWK in several ways. In the most direct applications of the six ways of knowing (and the transitions between them) to mathematics classrooms, researchers and teachers interpret them in relation to selection and/or design of representations of mathematical concepts and in relation to planning events of instruction. Joanne Rossi Becker and Judith Jacobs have focused on the representational problem (Becker and Jacobs, 1989; Jacobs, 1994). Discussing the theorem "The sum of any two odd numbers is even", Jacobs offers a representation of whole numbers by arrangements of squares in two horizontal (contiguous) rows and compares this representation with other which are common (e.g., 2n, 2n+1). The Jacobs representation is perceptual and generalizable by connected knowers (in theory, at least), allowing students to accumulate instances and develop "gut level" subjective knowledge of the odds and evens, and later the theorem itself. At issue in distinguishing this representation from others are the accessibility of the concept to subjective knowers and the (perceptual) attributes which invite reasoning (connected knowing). The role of visual perception in models such as this is especially interesting (and research worthy) because only a few years ago it was thought that women were demonstrably inferior with respect to visuo-spatial skills. Other direct approaches to the articulation of WWK into the classroom involve the development of pedagogies for connected learning (Becker, 1995); many of the studies sited below were conducted in classrooms which use such an approach, as does the SummerMath program for high school girls (Morrow and Morrow, 1995).

Feminist Pedagogy is an approach to teaching developed first in Women's Studies which decenters the authority of the teacher and conscientiously seeks to bring previously marginalized students into the mainstream of classroom activity and discussion (Culley and Portuges, 1985; Disch and Thompson, 1990) With

their emphases on voice, Gilligan's work and WWK provide both rationale and direction for this style of teaching; Several mathematics educators have experimented with feminist pedagogy, documenting the classroom events and using the ideas of voice, care, connectedness, and others in their analyses (Buerk, 1985, 1995, and others).

The importance of voice in all of this research is extended by some researchers to include writing, and the mathematics autobiography (usually written, sometimes oral) has gained an important place as a pedagogical and research tool. Dorothy Buerk (Buerk and Szablewski, 1993; Kalinowski and Buerk, in press) has extended the autobiography to include journals in which math students regularly write about their reactions, attitudes, and feelings in relation to mathematics and reflect upon themselves as knowers of mathematics. For researchers such as Buerk, these writings have become both research and pedagogical tools because of their demonstrated usefulness to the student. Extending the idea of bringing the margins into the mainstream, some researchers (e.g., Erchick, in press) are including in their conceptual frames (and/or mathematics classes) published writings about mathematics (and about women as knowers) authored by women who are not, by any of the usual definitions, mathematicians.

Reading across several of these studies, one is struck by the regularity with which women (including young teenagers) reveal themselves as currently or recently silent knowers with respect to mathematics, and, as importantly, that these women almost invariably report a salient critical event in which a statement or action by a teacher (or less frequently a family member) led to a resolve to be silent in the face of mathematics. Some of the events reported would make all of us cringe, but others are "standard fare" in the mathematics classroom.

> At about 8 or 9 I had a totally intimidating teacher (the headmaster) for maths, for one term. He taught us times-tables in a militaristic type of way; chanting out a times table, pointing at you and expecting you to fire back an answer within a second. If unable to answer some fate worse than death would be waiting. That is how it seemed when I was a completely powerless, timid 8-year-old. From then on started a slippery slope downhill. Although I had some good and encouraging teachers along the way, I had come to associate maths with fear and panic.
>
> (Isaacson, 1990, p. 23)

The writing and interviews of many women in these studies reflect their past, and often current, beliefs that math is an area in which one must learn from authorities. Frequently this belief remains a reified "fact" (gut level knowledge?) within a larger, more sophisticated way of knowing. In the following example, women in a group interview reveal how they moved beyond received knowing, rejecting the authority of the math teacher concerning their future mathematical needs, while still holding the mathematics, itself, to be knowledge which is gained from authority.

> Well, they just kind of came along and gave you sets of rules, didn't they? That's how I was taught, anyway.
>
> And little books to look them up in.
>
> Yeah, there's your rules. Off you go and use them ...
>
> If you've got something, and you don't know what you're ever going to use it for, you don't bother learning it.
>
> That's right.
>
> (Isaacson, 1990, p.25)

Across these studies, many women reflect on how the opportunity to talk or write about themselves as learners and doers of mathematics has helped them to establish a new relation with and understanding of the subject matter. In relation to this finding, some researchers (Fullerton, 1995) have examined mathematics register (see Pimm, 1987), finding that many women have no words with which to talk about mathematics. Through writing, interviews, and group work, they "came to voice" in mathematics.[10]

Examining these studies, it is interesting to see emerge in the data repeated mention by the participants of the very ideas that were captured in the original Fennema-Sherman scales and studies (Fennema and Sherman, 1977). These women often perceive math as a male domain, taught by "father-figures" (Rogers, 1990) and learned best by boys (Isaacson, 1990, among others). Reports on discouragement from the study of mathematics by mothers, fathers, teachers, and/or peers are a consistent presence across nearly all the studies (though not all women interviewed). Fear and panic (Isaacson, 1990) and other expressions of anxiety in the face of mathematics are reported frequently, as are lack of confidence and expectations of incompetence (Fullerton, 1995).

Thus, these studies provide a kind of retrospective construct validity for the Fennema-Sherman scales which *do* (still) capture salient aspects of women's expressions of their experiences, attitudes and feelings with regard to mathematics; these have not changed.[11] What the current research does, however, is provide a

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[10] The reader schooled and practiced in quantitative research methodologies may be thinking that none of this has the feel of "good science" and "hard data", so a few comments are in order. First, the research itself reflects a search for connected and constructed knowing. Where field data are gathered, the studies generally meet rigorous standards for qualitative research. Further, working from a base in feminist theory, the researchers are within a tradition that includes a serious critique of mainstrean science and which asks whether there can be a feminist science (see Damarin, 1994b, 1995a). While there is no final agreement on this question, certain characteristics emerge as essential for any candidate for feminist science: (1) the theorizing of gender as a variable of consequence, (2) the valuing of women;s experience as a scientific resource, and (3) the positioning of the researcher in the same critical plane as the researched. (Harding, 1987). In conducting their studies, the researchers clearly meet these criteria.

[11] The Fennema- Sherman scales were designed in an effort to predict success vs. failure and continuing vs. dropping enrollment by girls and young women in mathematics. These scales initiated research directed toward building explanatory models. Although the scales had less predictive power than hoped, they precipitated much research; a few of these scales (Math as a Male Domain, Anxiety, and perhaps others) are still used in model building studies.

way of seeing the constructs measured as *effects, not causes*. Early (and some current) research was designed on the assumption that negative experiences would cause students to do poorly in and/or leave mathematics. The studies discussed here reveal that, for many women, succeeding and staying in mathematics has the effect of creating increased opportunity to experience the negative phenomena captured in the scales. Many of the women in the current studies are high school and college mathematics students; some are school teachers (Erchick, 1995) and some are college professors (Taylor, 1990). They have endured, and sometimes learned, a lot of mathematics.

A note toward the future. The work of psychologist Valerie Walkerdine (1987, 1989, 1990) provides an important parallel to the studies influenced by *Women's Ways of Knowing*. Perhaps because she analyzes her data using the constructs and language of Marxist feminist theory, and more recently postmodern Foucauldian theory, her work is not very well-known to U.S. mathematics educators and gender researchers. In her work she addresses both classrooms in general (often at the elementary level) and mathematics classrooms, in particular. Borrowing analytic tools from Michel Foucault (1977), her most recent book analyzes the education of girls as the creation of "docile bodies", a term used by Foucault to examine the ways that persons become (are made) controlled, self-regulating, obedient subjects. Arguably, docile bodies are received, if not silent, knowers. A full mapping of the relations between WWK and Walkerdine's work is beyond the scope of this paper (and surely such a mapping would fail to be an isomorphism), but there is a commonality in methods, content of data, and some interpretations. Because a substantial amount of U.S., European, and Australian feminist theorizing and sociological study has "taken the postmodern turn," Walkerdine's work and similar efforts are likely to become more important to the study of gender and mathematics in the future.

Concerning Race and Ethnicity III

Belenky, Clinchy, Goldberger and Tarule were careful to include diverse women in their study: black, white, and Latina women ranging widely in age, and involved in educational settings ranging from a parenting skills workshop for welfare mothers to an elite women's college. This diversity notwithstanding, the conceptual roots of their work are clearly Euro-American, Gilligan's theoretical frame is based in psychoanalytic object relations theory, which assumes an autonomous self as central. This theory is appropriate to understanding knowledge building within a culture of individualism, but not (necessarily) within a culture which holds community as central, and/or values community over individual. Therefore, direct transfer of the theory from women to other mathematically marginal groups would violate "fairness in dealing."

Nonetheless, elements of this work would seem to have some relevance to race and ethnicity. First, the finding of the totalizing effects of silencing on students is not new to the literature, but replicates findings in relation to blacks, latinas, Native Americans and students for whom English is a second language. Secondly, the methods of these studies probably are transportable to work with other math-

ematically marginal populations. Feminist pedagogy has roots in the work of Paolo Freire (1970); and, black feminist bell hooks' (1994) book *Teaching to Transgress* is, in part, an explication and expansion of this method. Mathematical autobiographies of African American, Latino/Latina and other students would undoubtedly provide enlightening information. Moreover, given the importance attached to self-knowledge in optimal psychology, assigning mathematical autobiographies to black students might be both useful to these students and a start in mathematics educators' learning about and coming to appreciate their knowledge systems and values.

Third, half of all students of color are female, and are effected by the social constructions of women both within their ethnic cultures and in the dominant society. Although many black women state that race is primary to gender in defining their life experiences, African American historian of science Evelynn Hammonds (Sands, 1991) details how in collegiate and graduate work in physics, her sex was the major source of her oppression. Mathematics and mathematics classes may operate in a way similar to physics.

Finally, and perhaps most importantly, connected knowing is a central aspect of both Afrocentric epistemology and contemporary discussions in the literature on the education of black children. Connected Knowing, as described in WWK and elaborated in the studies is resonant with these discussions and suggests another area in which common approaches to educational change might be sought by women and blacks. Indeed, a careful look at the literatures of multicultural education and of ethnomathematics would surely reveal important insights which could be transported to research on the education of women (reversing the direction of the analysis and flow of inference in this paper).

Fixing the Mathematics

In the studies discussed above, the areas which emerge as in need of fixing include some in the category of teaching techniques, with some advice (but more questions) on how to select representations and organize instruction to teach toward subjective and connected ways of knowing. Some of this advice (not reiterated in this paper, but available in the studies referred to) has a familiar ring: teachers/readers are advised to use cooperative learning groups, teach to the individual's way of learning, adopt apprenticeship models and other aspects of situated learning theory, teach for cognitive construction of knowledge using constructivist methods, and so on.

The reader might ask, "isn't this just good teaching?" But, the question misses the major point of the authors which is the necessity to engage in good teaching *with specific attention to girls and women.*[12] These studies provide evidence that because the larger society (including many of their teachers, parents, and peers)

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[12] Specific attention to girls does not mean that boys are to be ignored. For years, the literature on gender and education has shown that girls get considerably less attention in classrooms (Maccoby and Jacklin, 1974, followed by numerous others). Unless teachers make it a specific effort to attend to girls, this will continue.

does not construct women and girls as competent in mathematics, young women must (re)construct themselves as (other than silent) knowers of mathematics. There is also evidence in these studies that writing and speaking about their experiences, attitudes, and feelings can contribute importantly to that self-construction.

WWK, with it's discussions of silence and received knowing, demonstrates that persons in these conditions of knowing cannot construct knowledge because they are rule-bound creatures who believe knowledge "just is" out there with someone, but not them (silent knowers); or, like special treats, hall passes, and the family car, knowledge is in the hands of the authorities who dole it out when they deem it to be appropriate for use in the designated situation (received knowers). Teaching these students "for constructivism" means changing their epistemologies (and self-concepts) and *then* teaching what we typically think of as "the mathematics."

"Fixing the mathematics" in the context of studies surrounding WWK, means bringing these issues of epistemology and the self as knower into the classroom as a part of the content of the curriculum and instructional activities. The mathematics autobiography, reflective journal, and related classroom discussion are offered as tools which have proven useful in this repair. But, we are warned that some students will need to learn how to use these tools, that is they will have to be taught a language with which to write and speak about mathematics and their reciprocal relation to it.

Although the research cited here provides a compelling rationale, the general idea is not entirely new. The *Standards* call for incorporating writing into mathematics classrooms; Dorothy Buerk has been doing so for a decade at least, and perhaps other teachers have as well. In *Caring*, Nel Noddings (1984) discusses the importance of having students who hate mathematics reflect on the meaning that withdrawal from math will have on their lives. Elsewhere (Damarin, 1990), I have argued that some of the messages about women and math that circulate in the press should be brought into classroom for discussion. In his recent book about mathematics and popular culture, Peter Appelbaum (1995) urges us to consider that all the messages about mathematics that we receive through the media (and he argues that there are many) are part of mathematics and must be brought into the classroom.[13]

If these seem like radical demands, there are other ways in which feminists are studying the question of "fixing the mathematics" which can make the use of mathematics autobiographies and teaching for connected knowing seem like "math class as usual". The effectiveness (for girls) of single sex mathematics classes has been amply demonstrated at SummerMath and other sites, and there appears to be an emergent movement in support of offering high school girls this option. The movement toward Afrocentric Magnet Schools across all grade levels springs from comparable concerns.

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[13] Applebaum's book has much to say about gender and mathematics and is important reading in this area.

Perhaps even more radical, there is a growing number of feminist researchers, both mathematicians and mathematics educators, who are examining the question of fixing the subject matter of mathematics itself. Leone Burton (1995) is working on a redefinition and reorganization of major strands of mathematics. In current work, I examine the ways in which fractions (in press) and probability (in preparation) reflect and contradict gender specific experience of the world by males and females respectively. A current issue of a women's studies journal includes a feminist critique of statistics (Hughes, 1995). And, at a recent conference on The Women, Gender, and Science Question, Ram Mahalingham (1995) and Bonnie Shulman (1995) each presented a critique of the foundations of mathematics based on feminist philosophy. For at least a decade, feminist philosophy and critique of science has invited this activity and provided some direction for it (see Damarin, 1995a, b). Moreover, the "new philosophers of mathematics" are revealing mathematics as a social-cultural-historical construction (Hersh, 1994); in this context, the patriarchal character of the social, the cultural, and the historical, as uncovered by feminist scholars in these areas, invites increased work in these directions.

Feminist epistemologists (e.g., Harding, 1993) and other feminist philosophers and sociologists encourage examination of mathematical concepts in relation to women's subjective experiences of the world. More interesting in the current context of psychology and mathematics education, French feminist philosophers with training and intellectual roots in Freudian and Lacanian psychoanalytic theory (e.g., Irigaray, 1985 1987, 1993; Wittig, 1992) argue that all science, including mathematics (and indeed all knowledge) is rooted in the "male imaginary" (e.g., phallic imagery, imagery of separation from the mother, the law of the father, etc.); the mathematics and science which result are (in their analyses) based on ideas of strict separation, boundaries, closure, duality, and related ideas. In the views of Irigaray and Wittig, true equality for women requires the grounding of (some) knowledge in a "feminine imaginary" based upon women's experience of their sexed (and gendered) bodies. In Irigaray's (1987) explication, a female-grounded mathematics would be based on ideas of connection, partial closure, in betweenness, and semi-permeable boundaries, among others. In the absence of a definition of what, exactly, mathematics is it is hard to examine the validity of these claims .... but, we do, indeed, live in interesting times.

Considering Race and Ethnicity IV

The centrality of Eurocentric thinking in this current work is evident in the references to psychoanalytic thinking. But, Afrocentric philosophy and psychology might also yield similar approaches to the creation of new mathematics (and may have done so already). Native American understandings of the world, Asian philosophies, and root belief systems of other cultures might also eventuate in some set of concepts and procedures which is arguably mathematics. As a stimulus to think about the possibility of misfit between our current mathematics and Afrocentric epistemologies, consider the following event.

> Some years ago a black psychologist gave a workshop on optimal psychology to a group of women recovering from alcohol, drug, and other dependencies. She opened her presentation by holding a pen firmly between her thumb and fingers, horizontal with its length visible to the audience of whom she asked. "Is this pen moving or is it still?" Within the next few minutes, she had elicited from the audience numerous answers involving the rotation of the earth, the movement of molecules, the relation of the pen to its molecules, the meaning of "still", her own (in)ability to be perfectly still, and many other issues. Assuring the audience that their answers were good, she went on to observe that the pen was both moving and still — not either moving or still, but *both moving and still.* What's more, all of our knowledge of the Universe comes together in the pen to make it the unique object that it is. She proceeded to describe a way of knowing the world (and themselves within it) in all its complexity and multiplicity, describing to the women a philosophy and a psychology in which either/or yields to both/and, and in which all things come together in each person. Choosing to focus on some things and not others is possible, and sometimes necessary, but focus is different from truth.

I do not know the mathematics to describe the simultaneous motion and stillness of the pen in the world, or the mathematics of both/and logic. But I do know that this simple introduction to one woman's understanding of Afrocentric thinking enriched my life and my understanding that there are indeed rich and valuable ways of knowing that I did not learn in school.

Concluding remarks

This paper maps a whirlwind journey from the question of everyday fairness in mathematics teaching to the psychological and epistemological underpinnings of mathematical thought. The short version of the paper is this:

> The question of fairness — or equity — in mathematics education is important, interesting, and deep. It is as deep and as difficult as any theorem of mathematics or theory of learning and education, and, in my view at least, more important. Partial answers to the question of how to deal fairly can be found at all levels, and fairness requires that we bring those answers into the mathematics classroom, not as final solutions, but as steps in a continuing process.

The journey sketched here is mine. Your journey, should you choose to make it, must be your own. Perhaps you will begin, not with feminist theory, but with theories of situated learning and the multi-cultural studies which support them. If so, your path will lead you through the work of Burke and McLellan (1995) to the

great black educational theorists of education: Booker T. Washington, who admonished black students to "cast down your buckets where you are" situating learning in current reality, and W. E. B. DuBois who disagreed and debated with him. Once in the domain of black history, you will likely happen upon Bob Moses and his work on Algebra as the new civil right (1995) and Frederick Douglass' analysis of racism as diseased imagination. Or, you may begin with a guided tour through some part of the literature of ethnomathematics. Stopping for rest, you will find yourself refreshed by a new-found understanding of the diversity of ways of interpreting the world and a profound respect for the abilities of all peoples to think, to understand, and to construct their own knowledge of the world and of themselves.

A Postmodern Deconstructive Afterword

Postmodern philosophies, afrocentric epistemology, and some feminist epistemology have in common the rejection of binary thinking. Rather than seeing a contradiction between A and not-A, they seek and embrace the simultaneous truth of both. Referred to as diunital logic in Afrocentric theory, this is the basis of the postmodern method of deconstruction.[14] Deconstructing an argument or the constellation of arguments which come together as a construct or theory is accomplished through stating many reversals of and exceptions to all implications, joining all of the new statements to their originals, and making whatever sense can be made of the totality. Deconstruction is reserved, in postmodern analysis for important constructs and texts; the process is lengthy and revealing (see Cherryholmes, 1988; Rosenau, 1991; Usher and Edwards, 1994).

Important arguments in the discourse of mathematics education are those which link race and gender with mathematical ability. The barrage of NAEP-type data, together with texts such as *The Bell Curve* (Herrnstein and Murray, 1994) are presented as "proof" that race, socio-economic status (class) and (to a lesser extent) gender predict mathematics ability and performance. What is not mentioned in these texts is that *gender, race, mathematics, ability*, and *performance* are all social constructions which operate in the construction of each other. Deconstructive readings of these data and texts make equally plausible a constellation of related statements including "mathematical performance predicts race and gender." One interpretation of this statement is that mathematical performance is a critical factor in defining roles of race and gender; that is, we learn how to perform in mathematics classes as a part of our learning of how to perform our roles in society as raced and gendered individuals. In this view, race and gender are not attributes we

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[14] In a series of discussions with Umesh Thakkar (an educational technologist from India, currently at the University of Illinois), he has argued that deconstruction and most other elements and ideas of postmodern philosophies and practice have been taken from Asian and African cultures and renamed in order to deny credit to their originators. For Thakkar, postmodernism is a new site of the continuing white intellectual exploitation of people of color.

have; they are activities we do. The critical questions become, how do you perform your gender? How do you perform your race?

In recent related qualitative sociological research on gender and technology (Grint and Gill, 1995) evidence was found to support the assertion that establishing and maintaining certain relations to (computer) technology is a critical factor in how individuals perform their masculinity or femininity. Relatedly, based on his analysis of popular discourse (TV shows, publicity about award winning teachers and about studies of girls and mathematics), Peter Appelbaum (1995) examines the ways mathematics contributes to the representation of gender in the popular culture, and thus to the socio-cultural construction of gender. TV, movies and the press, he finds, give their viewers gender specific directions on how to "do math." Also recently, qualitative researchers are reporting that young African Americans see their peers who excel in mathematics and science as "acting white" (Lattimore, 1995). All of this points to the need to examine ways in which mathematics is implicated both in students' construction of themselves as raced and gendered and in their performance of their gender and race.

Put another way, the mathematics classroom is a theater in which students perform their identities, choosing from the roles and scripts, and using the props available. Until we (the playwrights, producers, directors, and stage hands) produce some new characters, costumes, lines, and scenery this long running play is likely to go on...and on.

References

Appelbaum, Peter. (1995). Popular culture, educational discourse, and mathematics Albany: SUNY Press.

Asante, Molefi Kete. (1987). The Afrocentric idea. Philadelphia: Temple University Press.

Banks, James A. (June-July, 1993). The canon debate, knowledge construction, and multicultural education. Educational Researcher, 22, 4-14.

Becker, Joanne Rossi. (1995). Women's ways of knowing in mathematics. In Pat Rogers & Gabriele Kaiser (Eds.), Equity in mathematics education: Influences of feminism and culture (pp. 163-174). London: The Falmer Press.

Becker, Joanne Rossi, & Jacobs, Judith E. (1989) Communication in the WME Newsletter.

Belenky, Mary, Clinchy, Blythe M. , Goldberger, Nancy R. , & Tarule, Jill M. (1986). Women's ways of knowing: The development of self, voice, and mind. New York: Basic Books.

Bem, Sandra Lilsitz. (1993) The lenses of gender. New Haven, CT: Yale University Press.

Buerk, Dorothy. (1985). The voices of women making meaning in mathematics. Journal of Education 167, (3), 59-70.

Buerk, Dorothy. (1995). A response to the AERA research on gender and mathematics and new directions discussion. unpublished manuscript, mimeo.

Buerk, Dorothy, & Szablewski, Jackie. (1993). Getting beneath the mask: Moving out of silence. In Alvin White (Ed.), Essays in humanistic mathematics. Washington, DC: Mathematical Association of America.

Burke, Garfield, & McLellan, Hilary. (1995). The algebra project: Situated learning inspired by the Civil Rights Movement. In Hilary McLellan (Ed.), Situated learning perspectives. Englewood Cliffs, NJ: Educational Technology Publications.

Burton, Leone. (1995). Moving towards a feminist epistemology of mathematics. In Pat Rogers, & Gabriele Kaiser (Eds.), Equity in mathematics education: Influences of feminism and culture. London: The Falmer Press, 209-225.

Cherryholmes, Cleo H. (1988). Power and criticism: Poststructural investigations in education. New York: Teachers College Press.

Cohen, Patricia Cline. (1982). A calculating people: The spread of numeracy in early America. Chicago, IL: University of Chicago Press.

Collins, Patricia Hill. (1990). Black feminist thought: Knowledge, consciousness, and the politics of empowerment. Boston: Unwin Hyman.

Culley, Margo, & Portuges, Catherine (Eds.). (1985). Gendered subjects. New York: Routledge.

Damarin, Suzanne K. (in press). Thoughts on gender, fractions and toys. Focus on Learning Problems in Mathematics.

Damarin, Suzanne K. (1995a). Gender and mathematics from a feminist standpoint. In Walter Secada, Elizabeth Fennema, & Lisa Bird (Eds.), New approaches to equity in mathematics education (pp. 242-257). New York: Cambridge University Press.

Damarin, Suzanne K. (1995b). Experience, abstraction, and "algebra for all": Some thoughts on situations, algebra, and feminist research. In Carole, Lacampagne, William Blair, & Jim Kaput, (Eds.,), The Algebra Initiative Colloquium, (Vol. 2, pp. 127-136). Washington, DC: U.S. Department of Education.

Damarin, Suzanne K. (1994a). The emancipatory potential of situated learning. Educational Technology 34 (8). 16-22. (Also in Hilary McLellan (Ed.), Perspectives of situated learning, Englewood Cliffs: Educational Technology Publications. (in press)).

Damarin, Suzanne K. (1994b). Unthinking educational technology: A feminist imperative. Holistic Education Review 7 (1), 50-57.

Damarin, Suzanne K. (1994c). Equity, caring, and beyond: Can feminist ethics inform educational technology? Educational Technology 34 (2), 34-39.

Damarin, Suzanne K. (1993a). Technologies of the individual: Women and subjectivity in the age of information. Research in Technology and Philosophy, 13, 185-200.

Damarin, Suzanne K. (1993b). Schooling and situated knowledge: Travel or tourism? Educational Technology, 33, 27-32. (Also in Hilary McLellan (Ed.), Perspectives of Situated Learning, Englewood Cliffs: Educational Technology Publications (in press).)

Damarin, Suzanne K. (1990). Teaching mathematics: A feminist perspective. In Thomas J. Cooney (Ed.), Mathematics Teaching and Learning in the 1990's (pp. 144-151). Washington, DC: National Council of Teachers of Mathematics (1990 Yearbook).

Delpit, Lisa D. (1988). The silenced dialogue: Power and pedagogy in teaching other people's children. Harvard Educational Review 58 (3), 280-298.

Disch, Estelle, & Thompson, Becky. (1990). Teaching and learning from the heart. NWSA Journal 2, 68-78.

Donavan, Josephine. (1986). Feminist theory: The intellectual traditions of American feminism. New York: Ungar.

Eichler, Margrit. (1987). Nonsexist research methods: A practical guide. Boston: Allen and Unwin.

Erchick, Diana. (in press). Women's voices and the experience of mathematics. Focus on Learning Problems in Mathematics.

Erchick, Diana. (April 1995). Will the real authority please stand up? Teacher autobiographies areflection on practice. Paper presented at Research Pre-session, NCTM, Boston.

Fausto-Sterling, Anne. (1985). Myths of gender: Biological theories about women and men. New York: Basic Books.

Fennema, Elizabeth. (1993). Mathematics, gender, and research. Paper presented at the ICMI Conference on Gender and Mathematics, Hoor, Sweden.

Fennema, Elizabeth. (1990). Justice, equity, and mathematics education. In Elizabeth Fennema, & Gilah Leder (Eds.), Mathematics and gender (pp. 1-9). New York, Teachers College Press.

Fennema, Elizabeth, & Hart, Laurie E. (1994). Gender and the JRME. Journal for Research in Mathematics Education, 25, 648-659.

Fennema, Elizabeth & Peterson, Penny L. (1985). Autonomous learning behavior: A possible explanation of gender-related differences in mathematics, In Louise C. Wilkinson & Cora B. Marrett (Eds.), Gender-related differences in classroom interactions (pp.17-35). New York: Academic Press.

Fennema, Elizabeth, & Sherman, Julia A. (1977). Sex-related differences in mathematics achievement, spatial visualization, and affective factors. American Educational Research Journal 14 (3), 15-71.

Foucault, Michel. (1977). Discipline and punish: The birth of the prison. London: Penguin.

Frankenstein, Marilyn. (1995). Equity in mathematics education: Class in thew world outside the class. In Walter Secada, Elizabeth Fennema, & Lisa Bird (Eds.), New approaches to equity in mathematics education (pp. 165-190). New York: Cambridge University Press.

Frankenstein, Marilyn. (1987). Critical mathematics education: An application of Paolo Freire's epistemology. In Ira Shor (Ed.), Freire for the Classroom: A sourcebook for liberatory teaching (pp. 180-210). Portsmouth, NH: Heinemann.

Frazier, Nancy, & Sadker, Myra. (1973). Sexism in school and society. New York: Harper and Row.

Freire, Paolo. (1970). The pedagogy of the oppressed. New York: Continuum.

Friedman, Lynn. (Spring 1995). The space factor in mathematics: Gender differences. Review of Educational Research 65 (1), 22-50.

Fullerton, Olive. (1995). Who wants to feel stupid all the time? In Pat Rogers & Gabriele Kaiser (Eds.), Equity in mathematics education: Influences of feminism and culture (p. 37-48). London: The Falmer Press.

Gilligan, Carol. (1979). Woman's place in man's life cycle. Harvard Educational Review 47, 481-517.

Gilligan, Carol. (1982). In a different voice: Psychological theory and women's development. Cambridge, MA: Harvard University Press.

Gould, Stephen Jay. (1981). The Mismeasure of Man. New York: W.W. Norton.

Grint, Keith, & Gill, Rosalind, (Eds.). (1995). The gender-technology relation: Contemporary theory and research. London and Bristol, PA: Taylor and Francis.

Haraway, Donna. (1991). Primate visions: Gender, race, and nature in the world of modern science. New York: Routledge.

Harding, Sandra. (1993). Rethinking standpoint epistemology: What is "strong objectivity"? In Linda Alcoff & Elizabeth Potter (Eds.), Feminist epistemologies (p. 40-82). New York: Routledge.

Harding, Sandra (1991) The "Racial" Economy of Science. New York: Routledge.

Harding, Sandra. (1987). The method question. Hypatia: A Journal of Feminist Philosophy, 2 (3), 19-36.

Herrnstein, Richard, & Murray, Charles. (1994). The bell curve: Intelligence and class structure in American life. New York: Free Press.

hooks, bell. (1994). Teaching to transgress: Education as the practice of freedom. New York: Routledge.

Hughes, Donna M. (1995). Significant differences: the construction of knowledge, objectivity, and dominance. Women's Studies International Forum 18 (4), 395-406.

Irigaray, Luce. (1993). je, tu, nous: Toward a culture of difference. New York: Routledge.

Irigaray, Luce. (1987). Is the subject of science sexed? Hypatia: A Journal of Feminist Philosophy, 2, 32-44.

Irigaray, Luce. (1985). The sex which is not one. Ithaca, NY: Cornell University Press.

Isaacson, Zelda. (1990). "They look at you in absolute horror": Women writing and talking about mathematics. In Leone Burton (Ed.), Gender and mathematics: An international perspective (pp. 21-28). London: Cassell.

Jacobs, Judith. (1994). Feminist pedagogy and mathematics. Zentralblatt fur Didaktik der Mathematik, 94 (1), 12-17.

Jaggar, Allison M. (1983) Feminist politics and human nature. Totowa, NJ: Rowman and Allanheld.

Kaiser, Gabriele, & Rogers, Pat. (1995). Introduction: Equity in mathematics education. In Pat Rogers & Gabriele Kaiser (Eds.), Equity in mathematics education: Influences of feminism and culture (pp 1-10). London: The Falmer Press.

Kalinowski, Janet, & Buerk, Dorothy. (in press). Enhancing women's mathematical competence: An epistemological Analysis. NWSA Journal.

Kimball, Meredith M. (1989). A new perspective on women's math achievement. Psychological Bulletin, 105, 198-214.

Kimball, Meredith M. (in press). The Worlds We Live In: Gender Similarities and Differences. book manuscript.

Kramarae, Cheris, & Spender, Dale. (1992). The knowledge explosion: Generations of feminist scholarship. New York: Teachers College Press.

Ladson-Billings, Gloria. (1995). Making mathematics meaningful in multicultural contexts. In Walter Secada, Elizabeth Fennema, & Lisa Byrd Adajian (Eds.), New directions for equity in mathematics education (pp. 126-145). Cambridge and New York: Cambridge University Press.

Ladson-Billings, Gloria, & Tate, William F., IV (in press). Toward a critical race theory of education. Teachers College Record.

Lattimore, Randy. (1995). Assessing the competence of African American tenth graders in preparation for a mathematics proficiency test. (Dissertation proposal) The Ohio State University, mimeo.

Lewontin, R. C. (1992). Biology as Ideology. New York: Harper.

Linn, Marcia C., & Hyde, Janet L. (1989). Gender, mathematics, and science. Educational Researcher, 18. 22-27.

Lorde, Audre. (1984). Sister outsider. Freedom, CA: Crossing Press.

Maccoby, Eleanor E., & Jacklin, Carol N. (1974). The psychology of sex differences. Palo Alto, CA: Stanford University Press.

Mahalingham, Ram. (May 1995). Feminist mathematics: Is it possible? Implications for a multicultural mathematics education. Paper presented at the invited conference on The Women, Gender, and Science Question. University of Minnesota, Minneapolis.

Mellin-Olsen, Stieg. (1987). The politics of mathematics education. Dordrecht, Holland: D. Reidel.

Morrow, Charlene, & Morrow, James. (1995). Connecting women with mathematics. In Pat Rogers & Gabriele Kaiser (Eds.), Equity in mathematics education: Influences of feminism and culture (pp. 13-26). London: The Falmer Press.

Moses, Robert. (1995). Algebra, the new civil right. In Carole, Lacampagne, William Blair, & Jim Kaput, (Eds.), The Algebra Initiative Colloquium, (Vol. 2, pp. 53-67). Washington, DC: U.S. Department of Education.

Myers, Linda James. (1988). Understanding an Afrocentric world view: Introduction to an optimal psychology. Dubuque, Iowa: Kendall/Hunt.

National Council of Teachers of Mathematics. (1989). Curriculum and evaluation standards for school mathematics. Reston, VA: Author.

Noddings, Nel. (1993). Mathematics, politics, and pedagogy. In Sal Restivo, Jean Paul Van Bendegem, & Roland Fischer (Eds.), Math worlds: Philosophical and social studies of mathematics and mathematics education (pp. 150-161). Albany, NY: SUNY Press.

Noddings, Nel. (1992). The challenge to care in schools: An alternative approach to education. New York: Teachers College Press.

Noddings, Nel. (1984). Caring: A feminine approach to ethics and moral education. Berkeley: University of California Press.

Orenstein, Peggy. (1994). SchoolGirls: Young women, self-esteem and the confidence gap. New York: Doubleday.

Perry, William G. (1970). Forms of intellectual and ethical development in the college years. New York: Holt, Rinehart, and Winston.

Pimm, David. (1987). Speaking mathematically. London and New York: Routledge.

Rogers, Pat. (1990). Thoughts on power and pedagogy. In Leone Burton (Ed.), Gender and mathematics: An international perspective (pp. 38-46). London: Cassell.

Rogers, Pat, & Kaiser, Gabriele. (1995). Equity in mathematics education: Influences of feminism and culture. London and Washington, DC: The Falmer Press.

Rosenau, Pauline Marie. (1991). Post-modernism and the social sciences: Insights, inroads, and intrusions. Princeton, NJ: Princeton University Press.

Sadker, Myra, & Sadker, David. (1994). Failing at fairness: How our schools cheat girls. New York: Simon and Schuster.

Sands, Aimee. (1991). Never meant to survive: A black woman's journey. In Sandra Harding (Ed.), The "racial" economy of science (pp. 239-248). New York: Routledge.

Secada, Walter G. (1995). Social and critical dimensions for equity in mathematics education. In Walter Secada, Elizabeth Fennema, & Lisa Byrd Adajian (Eds.), New directions for equity in mathematics education (pp. 146-164). Cambridge and New York: Cambridge University Press.

Secada, Walter G. (November 1990). Needed: An agenda for equity in mathematics education. Journal for Research in Mathematics Education, 21 (5), 354-355.

Sherif, Carolyn Wood. (1979). Bias in psychology. In Julia A.Sherman and Evelyn Thornton Beck (Eds.), The prism of sex: Essays in the sociology of knowledge (pp. 93-133). Madison, WI: University of Wisconsin Press.

Shulman, Bonnie. (May 1995). What if we change our axioms? A feminist inquiry into the foundations of mathematics. Paper presented at the invited conference on The Women, Gender, and Science Question. University of Minnesota, Minneapolis.

Sleeter, Christine E., & Grant, Carl A. (1991). Mapping terrains of power: Student cultural knowledge versus classroom knowledge. In Christine E. Sleeter (Ed.), Empowerment through multicultural education (pp. 49-68). Albany, NY: SUNY Press.

Sleeter, Christine E., & Carl A. Grant. (1987). An analysis of multicultural education in the United States. Harvard Educational Review, 37 (4), 421-444.

Squire, Corrinne. (1989). Significant differences: Feminism in psychology. London and New York: Routledge.

Stiff, Lee V., & Harvey, William B. (1988). On the education of black children in mathematics. Journal of Black Studies, 19 (2), 190-203.

Stone, Lynda. (1994). The Education feminism reader. New York: Routledge.

Tartre, Lindsay. (1990). Spatial skills, gender, and mathematics. In Elizabeth Fennema & Gilah Leder (Eds.), Mathematics and gender (pp. 27-59). New York, Teachers College Press.

Taylor, Lyn. (1990). American female and male university professors' mathematical attitudes and life histories, In Leone Burton (Ed.), Gender and mathematics: An international perspective (pp. 47-59). London: Cassell.

Thompson, Helen B. (Woolley) (1903). The mental traits of sex. Chicago: University of Chicago Press.

Usher, Robin, & Edwards, Richard. (1994). Postmodernism and education. New York: Routledge.

Walker, Alice. (1983). In search of our mothers' gardens. New York: Harcourt, Brace, Jovanovich.

Walkerdine, Valerie. (1990). Schoolgirl fictions. London: Verso.

Walkerdine, Valerie, (Ed.). (1989). Counting girls out. London: Virago Press.

Walkerdine, Valerie. (1987). The mastery of reason: cognitive development and the production of rationality. London and New York: Routledge.

Weisstein, Naomi. (1971). Psychology constructs the female: or, The fantasy life of psychologists. In Michelle H. Garskof (Ed.), Roles women play: readings towards women's liberation (pp. 68-83). Belmont, CA: Freedom Press.

Wellesley Center for Research on Women. (1992). How schools shortchange girls: The AAUW Report. Washington, DC: American Association for University Women Educational Foundation.

Wittig, Monique. (1992). The straight mind. Boston: Beacon Press.

Woolley, Helen. (1903). see Thompson.

Woolley, Helen B. Thompson. (1910). Psychological literature: A review of the recent literature on the psychological of sex. Psychological Bulletin, 7, 335-342.